Articles

NEPA AND ALTERNATIVE ENERGY: WIND AS A CASE STUDY

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The fact that alternative energy projects will result in short or long term benefits to the environment does not mean that they are exempted from the effects of environmental protection legislation. The National Environmental Policy Act of 1969 (NEPA), with its environmental impact statement requirement, is a key part of the legal system of environmental protection. Wind energy, which is now receiving increasing attention as a potential energy source, can serve as a case study for the application of NEPA to alternative energy programs.

NEPA is a procedural statute, with the environmental impact statement (EIS) serving as the core of the process of environmental assessment NEPA is intended to require. An EIS is required where there is a "report or recommendation" for federal action significantly affecting the quality of the human environment. A number of judicial decisions and administrative regulations, particularly recent regulations of the Council on Environmental Quality (CEQ) elaborate on these requirements.

An awareness of NEPA requirements both ensures full consideration of environmental factors and lessens the potential burdens of compliance with the statute.

There is a romance to windmills, due perhaps to unconscious associations with Cervantes, Dutch landscapists and the lonely wrecked machines one sees on the prairie, evidence of old homesteads. Consequently, the idea that wind machines may become an important alternative source of energy in this country is intrinsically appealing.[1] Much

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1. A recent survey conducted by the Department of Health, Education and Welfare

has changed, though, since Don Quixote tilted with the slow-moving, linen-covered sails of a majestic windmill. One style of the new wind machines, developed under the auspices of NASA, bears a strong resemblance to a misplaced airplane engine, great knife-like blades reaching 200 feet or more into the sky, perched on a steel-truss transmission line tower. Other machines look for all the world like giant silvery eggbeaters. Efficient power generation might call for assembling these great machines in arrays or "wind farms" by the hundreds.

Not only the technology of wind machines has changed. A host of federal, state, and local statutes have been enacted over the past decade in the name of environmental protection. It is paradoxical but fundamentally important that there is no necessary exemption from these laws for alternative energy sources, even if a new project or technology will result in a net benefit to the environment.

Among the most important of these environmental statutes is the National Environmental Policy Act of 1969 (NEPA).[2] The purpose of this article is to identify for those engaged in alternative energy development the basic legal requirements of this statute and to outline a methodology for determining whether and when it applies.[3] To permit a more concrete discussion, wind energy will serve as a "case study"

found that a substantial majority (66.4%) of Americans aged 26 to 35 believe that windmills are the most desirable source of energy available, ranking ahead of nonpolluting solar energy collectors and hydroelectric power and far ahead of nuclear power, coal burning, coal gasification, and oil shale processing. Cited in 8 Energy Digest at 403-404 (No. 24, Dec. 31, 1978).

Indispensable to anyone concerned with the development of wind energy is *Legal-Institutional Implications of Wind Energy Conversion Systems* (WECS), NSF/RA-770204 (NSF; Sept. 1977) (NTIS; GPO Stock #038-000-00339-9), a report to the National Science Foundation prepared by George Washington University's Program of Policy Studies in Science and Technology under Prof. Louis H. Mayo's direction [hereinafter cited as *Wind Legal-Institutional Implications*], which surveys virtually every legal issue which will or may be raised by wind energy.

2. 42 U.S.C. §§ 4321, 4331-4335, 4341-4347 (1970).

3. This is not a "how to" guide on preparing an environmental impact statement. Many other publications, notably the Practising Law Institute's *Environmental Impact Statements: A Guide to Preparation and Review* (New York: PLI; 1977), already serve that function. Furthermore, recent regulations of the Council on Environmental Quality, 43 Fed. Reg. 55,978 (Nov. 29, 1978) (to be codified in 40 C.F.R. pts 1500-1508), set out in detail the timing and procedural steps of impact statement preparation. This article is concerned with whether an environmental impact statement must be prepared, not with what must be included in it. Thus the requirement that alternatives to a proposed federal action be considered during preparation of the EIS, an issue which has been so important in NEPA cases, *see* Natural Resources Defense Council v. Morton, 458 F.2d 827, 837 (1972); Calvert Cliffs Coordinating Comm. v. AEC, 449 F.2d 1109 (D.C. Cir. 1971); and NRDC v. Hughes, 437 F. Supp. 981, 990 (D.D.C. 1977), *modified*, 454 F. Supp. 148 (D.D.C. 1978), is not discussed.

for the application of NEPA, but the basic principles adduced have broad application to the development of all alternative forms of energy.[4]

NEPA can be written off as a "paper tiger"[5] or hailed as the Magna Carta of the environment.[6] Neither description is true — nor entirely false. On one hand, the fundamental thrust of NEPA is procedural rather than substantive, for the statute requires meticulous documentation of the impacts of a proposed project in an "environmental impact statement" (EIS), but does not bar implementation of a project having adverse environment effects, provided the requisite procedures have been followed.[7] On the other hand, NEPA has undoubtedly affected both the method and the substance of decisionmaking affecting the environment, by forcing those responsible for a project to confront, publicly and in detail, the environmental consequences of their actions. Furthermore, the possible penalty for inadequate compliance with the requirements of NEPA is a lawsuit, which can entail substantial delay in project commencement, with increased project costs.[8] More than

4. Many states and localities have passed "little NEPAs" which may be applicable to a given project and may require impact statement preparation. Early inquiry with appropriate state officials is advisable to reduce duplication and permit simultaneous fulfillment of federal and state requirements.
5. W. H. Rodgers, Jr., *Handbook on Environmental Law* (St. Paul, Minn.: West Pub. Co.; 1977) at 697 [hereinafter cited as *Handbook*].
6. R. A. Liroff, ed., "Conference Manual," Conference on the *Environmental Impact Statement Process Under NEPA-III*, Oct. 31-Nov. 1, 1978; Wash., D.C. (Wash., D.C.: Environmental Law Institute; Dec. 1978) at i-1.
7. Whether NEPA has substantive as well as procedural requirements, thereby authorizing courts to review agency decisions on the merits and to remand or reverse an environmentally harmful agency decision, *even if* all the requisite procedural steps have been duly followed, is a troubled and much-analyzed question; a partial list of the many articles on the subject appears in *Handbook*, *supra* note 5, at 738 n. 1. The Supreme Court's opinion in Kleppe v. Sierra Club, 427 U.S. 390, 410 (1976), suggests (though in dictum) that such judicial inquiry into the substantive merits of agency decision is inappropriate under NEPA: "The only role for a court is to insure the agency has taken a 'hard look' at environmental consequences; it cannot 'interject itself within the area of discretion of the executive as to the choice of action to be taken.'"

   The same conclusion is more forcefully stated in national Helium Corp. v. Morton, 486 F.2d 995 (10th Cir. 1973), *cert. denied*, 416 U.S. 993 (1974); Manygoats v. Kleppe, 558 F.2d 556 (10 Cir. 1977); Lathan v. Brinegar, 506 F.2d 677 (9th Cir. 1974); and Short Haul Survival Comm. v. United States, 572 F.2d 240 (9th Cir. 1978). Several other circuits, however, accept the principle of substantive review under NEPA. *See, e.g.*, Environmental Defense Fund, Inc. v. Corps of Engineers (Gillham Dam), 470 F.2d 289 (8th Cir. 1972), *cert. denied*, 412 U.S. 931 (1973); and Jackson County v. Jones, 571 F.2d 1004 (8th Cir. 1978). *See also* Conservation Council v. Froehlke, 473 F.2d 664 (4th Cir. 1973); and Sierra Club v. Froehlke, 486 F.2d 946 (7th Cir. 1973).
8. Litigation under NEPA has been facilitated by the courts' liberal interpretation

one project has been effectively modified, made more costly, or even terminated by a lengthy NEPA lawsuit.[9]

I
THE IMPACT STATEMENT REQUIREMENT

The heart of NEPA is Section 102(2)(C), which requires that for "every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment," a detailed statement must be prepared on (i) the

of who has standing to sue an agency for inadequate compliance with the statute. The oft-recited formula is that a plaintiff must allege (1) that the challenged administrative action will cause him injury in fact and (2) that the injury is to an interest arguably within the zone of interests protected by NEPA. In practice, these requirements are easily met. In United States v. Students Challenging Regulatory Agency Procedures (SCRAP I), 412 U.S. 669 (1973), the Supreme Court found standing under NEPA despite what the Court acknowledged to be an "attenuated line of causation": namely, that an ICC-approved railroad rate increase would cause increased use of nonrecyclable goods as compared to recyclable goods, thus resulting in more refuse being discarded in the national parks, forests, streams, and other resources in the Washington, D.C., area enjoyed by plaintiffs and in the need to consume more natural resources, some of which might be extracted from the Washington area. Injury to aesthetic, conservational, and recreational interests clearly suffices to confer standing. *Id.* at 686-687; Sierra Club v. Morton, 405 U.S. 727, 733 (1972). At least one recent case suggests that injury to "informational interests" — *i.e.*, the public's right to know — also confers standing under NEPA. Natural Resources Defense Council v. SEC, 432 F. Supp. 1190, 1197 (D.D.C. 1977). The lesson of these cases is that an individual aggrieved by an agency project, whether for environmentally sound or purely selfish reasons, will find it easy to win standing to sue the agency for inadequate compliance with NEPA. Well-documented and careful compliance with the statute must then become the agency's defense.

An illustration of the potential for delay, for good or ill, in a NEPA lawsuit is the coal leasing moratorium. The Department of Interior has been trying since 1974 to lift a moratorium it imposed in 1970 on regular coal leasing of federal lands. A 1975 EIS was rejected in NRDC v. Hughes, 437 F. Supp. 981 (D.D.C. 1977), *modified*, 474 F. Supp. 148 (D.D.C. 1978), to permit limited leasing in special circumstances. More than four years after its first draft EIS, Interior issued a new draft EIS in December 1978. A final EIS and a decision by the Secretary of Interior are expected in mid- to late-1979, and the Interior Department's Bureau of Land Management is apparently gearing up "to be ready for a possible coal lease sale in mid-1980," 10 years after the moratorium began. K. Markey, "Coal Leasing Controversy Climaxes. *Not Man Apart*. vol. 9 (no. 3): at 8; Feb.-March 1979.

9. The statistics in the Council on Environmental Quality's Ninth Annual Report — 1978 at 407-409 are illustrative. As of Dec. 31, 1977, 938 NEPA cases had been filed against federal agencies. In 202 cases, projects were delayed by injunctions granted under NEPA. In 92 of these, projects were delayed for more than one year. Sixty projects were cancelled following an injunction under NEPA, although the reasons given for abandonment varied considerably.

environmental impact of the proposed action, (ii) any adverse environmental effects, (iii) alternatives to the proposed action, (iv) the relationship between short-term uses and long-term productivity of the environment and (v) any irreversible commitments of resources entailed in the proposed action. This statutory language, though brief, frames the critical issue in determining whether an environmental impact statement is required: (1) Is there a "proposal" for (2) federal legislation or other "federal" action (3) that is "major" and will "significantly affect" the quality of the human environment? A number of subtle and in some cases controversial legal questions lurk behind this simple formula. To help tease out and arrange these questions into a format usable by decisionmakers in determining whether an impact statement is required, the federal program for wind energy development provides a useful example.

II
WIND ENERGY: PAST AND FUTURE

Humanity's reliance on the wind as a source of energy has a long history. Wind machines for grinding grain were developed by the Persians before the birth of Christ, and windmills were extensively used throughout Europe from late medieval times on, particularly by the Dutch to drain and reclaim marshlands.[10] In the United States, wind machines were common during much of the 19th and early 20th centuries, receiving wide use at farms and other rural locations, primarily for pumping water, but eventually also for small-scale electrical generating.[11] Development of other energy sources and the rural electrification programs of the 1930s spelled an end to this broad-based reliance on wind, although one of the few large-scale applications in this country, the Grandpa's Knob (Vermont) horizontal axis machine, with a peak power output rating of 1.25 megawatts (MW),[12] fed into the local utility grid, was successfully operated during the early 1940s until throwing a blade in 1945.[13]

10. N. Cheremisinoff, *Fundamentals of Wind Energy* (Ann Arbor, Mich.: Science Publishers; 1978) at 15-16.
11. *Id.* at 4, 21-28.
12. One megawatt equals 1,000 kW. The average annual consumption of a home in the Public Service Company of Colorado's service area for 1978 was 5,724 kilowatt-hours (kWh). Public Service Co.., 1978 Annual Report (prelim. draft). A 1 MW wind machine, operating 3,000 to 5,000 hours per year, with a capacity factor of .5, would thus provide sufficient electricity for approximately 250 to 450 homes.
13. US Energy Research and Development Administration, *Solar Program Assessment:*

In the 1970s, with the looming of the "energy crisis," there is renewed interest in harnessing the energy of the winds. Wind energy conversion systems (WECS) constitute one of eight principal solar technologies being funded by the federal government. The federal wind energy program was begun in 1973 under the National Science Foundation and is now the responsibility of the Department of Energy (DOE), with technical and management support from the National Aeronautics and Space Administration.[14] The basic program objective is to effect the "earliest possible" commercialization and widespread use of reliable wind energy systems.[15] Program elements include measurement of the national wind resource, identification of suitable, regions and sites for wind energy, assessment of technical, economic and legal prerequisites for widespread use of wind energy, research on innovative wind systems and components, and development and field testing of large (1 MW or more), intermediate (.1 to 1 MW), and small (less than .1 MW) wind machines.[16] Primary emphasis in the present program is on providing utility grid electric power with the largest possible machines. Accordingly, DOE is engaged in an extensive testing program for large horizontal axis machines, including an operational .1 MW machine, three .2 MW machines, two of which are operational, and a 2 MW machine, scheduled to become operational at Boone, North Carolina, in 1979. In addition, small wind systems and vertical axis machines are being tested at various DOE facilities. A program for installing one or two small, commercially available machines in each state to uncover institutional and technical barriers to widespread use is in the final planning stages. Over the past three fiscal years, the federal funding level for wind energy has increased from $27.6 to $35.1 to, in FY79, $60.7 millions.[17]

Private testing and commercialization of wind energy systems is also occurring. Southern California Edison plans to commence operation of a 3 MW machine, located near Palm Springs, California, for a

Environmental Factors — Wind Energy Conversion, ERDA 77-47/6 (Wash., D.C.: ERDA; March 1977) (GPO Stock #060-000-00061-1) at 6 [hereinafter cited as *ERDA Wind Environmental Assessment*].

14. Domestic Policy Review of Solar Energy Integration Group, *Status Report on Solar Energy Domestic Policy Review* (Public Review Copy, Aug. 25, 1978) at IV-7 [hereinafter cited as *Domestic Policy Review*].
15. *Id.*
16. The information in this paragraph is drawn from descriptions of the federal wind energy program in the Domestic Policy Review, *supra* note 14, at III-7 and IV-7; and Solar Energy Research Institute, L. Perelman, ed., *Annual Review of Solar Energy*, SERI/TR-54-066 (Golden, CO: SERI; Nov. 1978) (NTIS) at 105-109.
17. *Domestic Policy Review, supra* note 14, at IV-7.

two-year test period starting in spring 1979.[18] WTG Energy Systems, Inc. has begun operation of a .2 MW machine on Cuttyhunk Island off Martha's Vineyard, Massachusetts.[19] Alcoa, which recently installed a vertical axis machine at Clarkson College in New York state, has, to date, sold 16 machines ranging in output from .01 MW to .22 MW.[20] There is also a small commercial wind industry, consisting of about 15 to 20 firms manufacturing machines in the 1 to 6 kilowatt range.[21]

The Solar Domestic Policy Review predicts a massive expansion in wind-generated energy by the end of the century, in the range of .6 to 3 quads[22] depending on the price of conventional fuels and the level of government incentives.[23] An estimated 15,000 1.5 MW machines (or their equivalent in smaller machines) would be operated under the "base case" of .6 quads, while the "technical limit" case of 3 quads would require some 75,000 large machines.[24]

III
WIND ENERGY DEVELOPMENT AND NEPA

One of the reasons that wind energy development provides a good NEPA case study is that, on its face, wind seems such an environmentally innocuous form of energy. "[A] major source of inexhaustible, virtually pollution-free energy" is the way one federal document describes it.[25] Wind may well prove to be one of the most desirable energy alternatives. Nevertheless, there is no environmental "free lunch" in the production of energy, and even wind energy has its impacts on the environment. The analysis which follows is intended to highlight the paradox that even an environmentally preferable energy alternative may be subject to the requirements of NEPA and, for the common good, rightly so.

A checklist for determining whether NEPA applies to a given project

18. Fact Sheet provided by R. L. Scheffler, Program Director, Wind Turbine Generator Demonstration Project, Southern California Edison Company, with letter of Oct. 26, 1978.
19. 4 *Solar Energy Intelligence Report* (No. 43, Oct. 30, 1978) at 334.
20. *Id.*
21. *Domestic Policy Review, supra* note 14, at III-7.
22. A quad is a large quantity of energy, one quadrillion British Thermal Units (Btu). Total US energy demand by the year 2000 is estimated at 95 to 132 quads in the *Domestic Policy Review, supra* note 14, Table V-II.
23. *Id.* V-9, V-10.
24. *Id.*
25. U.S. Dept. of Energy, *Final Environmental Impact Statement: Wind Turbine Generator System, Block Island, R.I.*, (DOE/EIS-0006) (NTIS), at 11 [hereinafter cited as *Block Island EIS*], *noted* in 43 Fed. Reg. 39,634 (Sept. 6, 1978).

can be formulated as a sequence of questions:

1. Is there a "report or recommendation on a proposal" for action?
2. Is the action "federal"?
3. Would the action contemplated constitute "major" action "significantly affecting the quality of the human environment"?

Decided cases and administrative regulations implementing NEPA are indispensable in applying these questions to a particular project. Until recently, there existed no uniform, governmentwide set of regulations on NEPA; instead, some 70 different sets of individual agency regulations, plus the "advisory" Guidelines of the Council on Environmental Quality, created a complex and sometimes inconsistent body of administrative regulations. On November 29, 1978, pursuant to Executive Order 11991 (May 24, 1977), the Council on Environmental Quality issued regulations which are binding on all federal agencies and are intended to provide "uniform standards applicable throughout the federal government for conducting environmental reviews."[26] Several of the new CEQ regulations are controversial, and their substance, as well as their mandatory nature, may well be challenged in court. Nevertheless, the regulations will undoubtedly have a major influence on the administration of NEPA. Accordingly, this article will refer extensively to the new regulations.

A. Has the Agency Made a "Report or Recommendation on a Proposal" for Action?

Timing is important in impact statement preparation. NEPA requires federal agencies to consider the environmental consequences of their actions *during* the decisionmaking process on a project,[27] not after, when options may have been foreclosed, agency commitments set, and

26. 43 Fed. Reg. 55,978 (1978). An analysis of the new CEQ regulations, with recommendations for amendments to integrate further the EIS with agency decisionmaking, appears in Note, *Implementation of the Environmental Statement*, 88 YALE L.J. 596 (1979).
27. Calvert Cliffs Coordinating Comm. v. AEC, 449 F.2d 1109, 1118 (D.C. Cir. 1971), *cert. denied*, 404 U.S. 942 (1972) ("Compliance to the 'fullest' possible extent [with NEPA] would seem to demand that environmental issues be considered at every important stage in the decision-making process concerning a particular action — at every stage where an overall balancing of environmental and nonenvironmental factors is appropriate and where alterations might be made in the proposed action to minimize environmental costs"). *See also* Lathan v. Volpe, 350 F. Supp. 262, 266, *aff'd*, 506 F.2d 677 (9th Cir. 1974) ("NEPA ... does not authorize defendants to meet their responsibilities by locking the barn door after the horses are stolen").

the momentum of a particular program become well-nigh irresistible.[28] Thus, the threshold question which an agency must address in complying with NEPA is whether a "report or recommendation on a proposal" for action exists.

In two key decisions on impact statement timing, *Aberdeen & Rockfish Railway v. Students Challenging Regulatory Agency Procedures (SCRAP II)*[29] and *Kleppe v. Sierra Club*,[30] the Supreme Court has twice overturned lower court holdings that an agency delayed too long in preparing an impact statement. In *Kleppe* the Court held that NEPA "clearly states" when an impact statement is required; namely, when an agency "makes a recommendation or report on a *proposal* for federal action."[31] Unfortunately this literal recitation of the words of NEPA does not provide meaningful guidance because the terms used are defined by neither the statute nor the Court. Furthermore, federal decisionmaking can be an exceedingly complex process. Input on the nature, feasibility or desirability of a given project may come from several agencies or levels within an agency and, consequently, it becomes difficult to identify the precise point at which a "recommendation or report on a proposal" has in fact emerged.

The danger of too-literal reliance on the terms of the statute is that a formal "recommendation or report on a proposal" may not appear until an agency's actual decisionmaking process is virtually complete, thus short-circuiting the environmentally informed decisions which NEPA is meant to promote. At the same time, there would be obvious disadvantages in requiring compliance with NEPA too early in agency deliberations, when the opportunity to "brainstorm" and speculate freely can promote creative policymaking. The *SCRAP II* and *Kleppe* decisions weight the balance in favor of free deliberation by increasing agency discretion in determining when an impact statement must be prepared, to a degree which some criticize:

> The Court comes very close to allowing an agency to dictate the timing of statement preparation by the simple expedient of withholding the proposal characterization from its plans for future development. . . . As a practical matter . . . the chief determinant of whether a proposal exists depends upon whether the agency says it is so.[32]

28. *Handbook, supra* note 5, at 767.
29. 422 U.S. 289 (1975).
30. 427 U.S. 390 (1976).
31. 427 U.S. at 406 (emphasis original).
32. *Handbook, supra* note 5, at 773. A complex, four-part "balancing" test for deter-

Treading a thin line, the new CEQ regulations attempt to require the earliest possible agency consideration of environmental factors without running afoul of *Kleppe* and *SCRAP II*. The new regulations state: "Agencies shall integrate the NEPA process with other planning at the earliest possible time. . . ."[33]

> An agency shall *commence* preparation of an environmental impact statement as close as possible to the time the agency is developing or is presented with a *proposal* . . . so that preparation can be *completed* in time for the final statement to be included in any *recommendation or report* on the proposal.[34]

A "proposal" is defined to exist

> at that stage in the development of an action when an agency . . . has a goal and is actively preparing to make a decision on one or more alternative means of accomplishing that goal and the effects can be meaningfully evaluated. . . . A proposal *may exist in fact* as well as by agency declaration that one exists.[35]

Thus, under the CEQ regulations, a "proposal" triggers a requirement to "commence" preparation of the impact statement. However, the completed statement is required only when a "recommendation or report" on the proposal is made, which the regulations characterize as the "feasibility analysis (go-no go) stage" for projects directly undertaken by federal agencies.[36]

Timely identification of "proposals" and "recommendations" requires constant assessment of the status of agency programs and keen awareness that agency "action" may take many different forms, from an agency's simple approval of a private application for a permit, to an agency's development of a specific project at a specific site, to adoption of a broad agency program involving numerous individual projects. The scope of the impact statement required varies accordingly. A site-

mining when at EIS has to be prepared was set forth in Scientists' Institute for Public Information, Inc. v. AEC, 481 F.2d 1079 (D.C. Cir. 1973); however, in *Kleppe*, the Supreme Court gave short shrift to this effort, stating, "A court has no authority to depart from the statutory language and, by a balancing of court-devised factors, determine a point during the germination process of a potential proposal at *which an impact statement should be prepared.*" 427 U.S. at 406 (emphasis original).

33. 43 Fed. Reg. 55,995 (1978) (to be codified in 40 C.F.R. § 1501.2).
34. *Id.* (to be codified in 40 C.F.R. § 1502.5) (emphasis added).
35. 43 Fed. Reg. 56,005 (1978) (to be codified in 40 C.F.R. § 1508.23) (emphasis added).
36. 43 Fed. Reg. 55,995 (1978) (to be codified in 40 C.F.R. § 1502.5(a)).

specific EIS, focused on an individual action and the impact on its immediate surroundings, may be appropriate in certain circumstances. Other federal actions or combinations of actions may call for a "regional" EIS, focused on environmental consequences over a large geographic area, or even for a "programmatic" EIS, which evaluates in the broadest possible terms the impacts of an agency program or policy.[37] Even a federal research and development program, though distinct from implementation of a particular technology, may require EIS preparation.[38]

The new CEQ regulations emphasize that impact statements may be required "for *broad federal actions* such as the adoption of new agency programs or regulations."[39] Accordingly, agencies should evaluate proposals "geographically," "generically," and "by stage of technological development."[40] Adoption of "formal plans," "programs," or "systematic and connected agency decisions allocating agency resources" may constitute an "action" requiring an appropriately scaled impact statement.[41]

Therefore, inseparable from the question of when an impact statement is required on a given action is the issue of the proper *scope* of the statement: for example, should a given action be treated as part of an existing broad program, suitable for immediate consideration in a "programmatic" EIS, or as a self-contained project, which should be evaluated in a future "site-specific" EIS? In response to this problem, the new CEQ regulations incorporate the concept of "tiering," defined as

> the coverage of general matters in broader environmental impact statements (such as national program or policy statements) with subsequent narrower statements or environ-

37. *See* Kleppe v. Sierra Club, 427 U.S. at 409-412, where the Court said: "[NEPA] may require a comprehensive impact statement in certain situations where several proposed actions are pending at the same time. . . . Thus, when several proposals for coal-related actions that will have cumulative or synergistic environmental impact upon a region are pending concurrently before an agency, their environmental consequences must be considered together." The Court noted with approval that the Interior Department had conceded the need for a coal programmatic EIS in connection with the new national coal leasing program, observing that "the new leasing program is a coherent plan of national scope, and its adoption surely has significant environmental consequences." 427 U.S. at 400. *See also* Atchison, T. & S.F. Ry. v. Callaway, 382 F. Supp. 610 (D.D.C. 1974); Natural Resources Defense Council v. Morton, 388 F. Supp. 829 (D.D.C. 1974); and NRDC v. TVA, 367 F. Supp 128 (E.D. Tenn. 1973).
38. Scientists' Institute for Public Information, Inc. v. AEC, 481 F.2d 1072 (D.C. Cir. 1973) (AEC required to prepare programmatic EIS on Liquid Metal Fast Breeder Reactor study program).
39. 43 Fed. Reg. 55,995 (1978) (to be codified in 40 C.F.R. § 1052.4) (emphasis added).
40. *Id.*
41. 43 Fed. Reg. 56,005 (1978) (to be codified in 40 C.F.R. § 1508.18(b)).

> mental analyses (such as regional or . . . site-specific statements) incorporating by reference the general discussion and concentrating solely on the issues specific to the statement subsequently prepared.[42]

Tiering is intended to eliminate repetitive discussions of the same issues and to permit agencies to focus on the actual issues ripe for decision at each level of environmental review.[43] The tiering concept permits an agency to prepare an EIS more efficiently and with less paperwork; consideration of its possible usefulness should occur early in an agency's deliberations on a given program.

Applying these concepts of timing and scope to the present federal wind energy efforts would require detailed analysis of the status of every action which the program entails, to determine which actions, combinations of actions, or programs are at the "proposal" stage, which is beyond the scope of this article. However, proper agency resolution of the issues of timing and scope which NEPA presents would be fostered by the following specific institutional arrangements: (1) a central agency office for NEPA compliance,[44] charged with periodically assessing programs and actions to determine which have ripened into "proposals" or "reports or recommendations"; (2) guidance from the central NEPA office to project officers throughout the agency, so that those planning and implementing projects become sensitive to the kinds of actions which should be reported for assessment; and (3) good lines of communication from project officers to the central NEPA office, to insure well-informed oversight of NEPA matters.

B. Is the Action Proposed "Federal"?

Projects directly conceived and carried out by the federal government clearly meet the "federal action" requirement of NEPA. Present federal wind energy efforts, consisting principally of federally managed research and testing, have an obvious federal involvement. As federal research efforts bear fruit, commercialization becomes feasible, and

42. 43 Fed. Reg. 56,006 (1978) (to be codified in 40 C.F.R. § 1508.28).
43. 43 Fed. Reg. 55,984 (1978) (to be codified in 40 C.F.R. § 150).
44. There is a central Office of NEPA Affairs in the Department of Energy, which has been active in the wind energy area. An EIS and numerous environmental analyses on alternative sites were prepared on the Block Island .2 MW machine. (*See* note 25, *supra*). In addition, a programmatic environmental analysis to determine whether large-scale wind energy development and commercialization will require preparation of an EIS is underway and will be completed sometime in 1979.

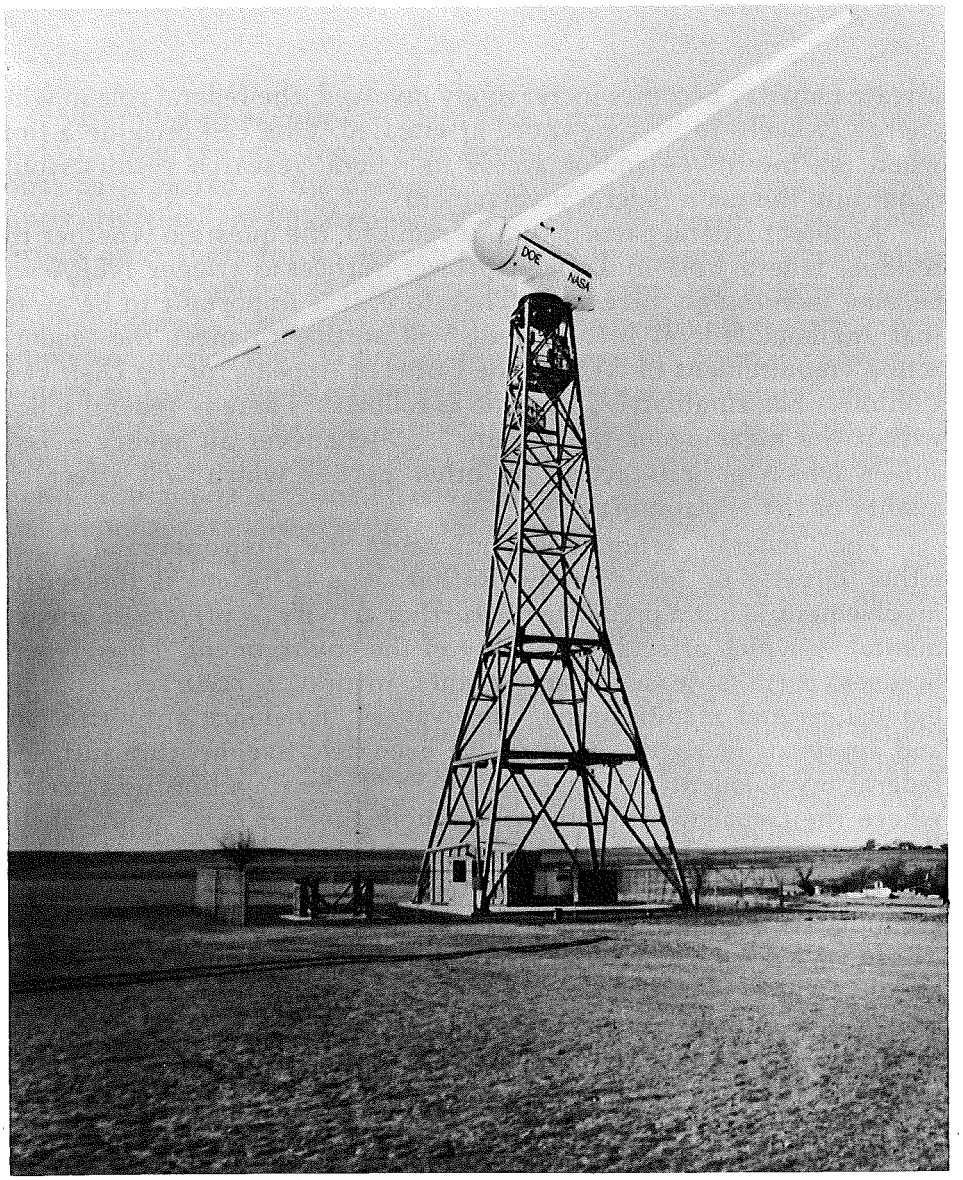


Photo — U.S. Department of Energy

This 200-kilowatt wind turbine generator supplies part of the electric power used by Clayton, New Mexico. Part of a DOE test project, it was built under management of NASA's Lewis Research Center. Many other machines, some significantly larger than this one, are in operation or under construction. Large arrays of such devices may well have significant environmental consequences.

private industry becomes increasingly involved, the federal role in wind energy is likely to become more attenuated. One can imagine a time when tax incentives and/or access to federal research results would constitute the main federal involvement.

As direct federal participation is reduced, the question whether the residual federal role in a given project suffices to trigger NEPA will become increasingly pertinent. Therefore, it is important to be aware that minimal federal involvement will suffice to meet the "federal action" requirement of NEPA. The Court of Appeals for the District of Columbia has summarized the rule as follows: "There is 'federal action' within the meaning of the statute . . . whenever an agency *makes* a *decision* which permits action by other parties which will affect the quality of the environment."[45]

The "federal" action need not cause the environmental impact either directly or immediately. Rather, it is sufficient if the federal involvement is but a predicate for further activity — private or governmental — which affects the quality of the environment. Thus, federal licenses, permits, leases, loans, grants, insurance, contracts, contract extensions and modifications, conveyances, assistance authorizations, and approvals of rights of way have been held to constitute sufficient federal involvement to trigger NEPA.[46] "Federal" action was present where the Department of Interior simply gave *pro forma* approval to a leasing agreement between a private developer and an Indian pueblo,[47] and where a federal commission's role in reviewing and "approving" a rezoning request was advisory only.[48]

In such cases, the federal role was peripheral to the actual decision, making which would affect the environment, yet NEPA applied. In sum, if a federal agency will in any material respect control or influence whether or how an action will occur, then the "federal" action requirement of Section 102(2)(C) is probably satisfied.

C. *Would the Action Contemplated Constitute "Major" Action "Significantly Affecting" the Environment?*

45. Scientists' Institute for Public Information, Inc. v. AEC, 481 F.2d 1079, 1088 (1973) (emphasis added).
46. *See Handbook, supra* note 5, at 762 and cases cited therein.
47. Davis v. Morton, 469 F.2d 593 (10th Cir. 1972).
48. McLean Gardens Residents Ass'n v. Nat'l Capital Planning Comm'n, 390 F. Supp. 165 (D.D.C. 1974). *See also* Scenic Rivers Ass'n v. Lynn, 520 F.2d 240 (10th Cir. 1975), *rev'd on other grounds*, 423 U.S. 1013 (1976) (simple review and approval by Housing and Urban Development Department of factual statement required to be put on file by private land developers held to constitute "federal" action).

Assuming an agency has identified a proposed action and decided that its role renders the action federal, NEPA applies, and an EIS must be prepared, *if* the proposal constitutes "major" action "significantly affecting" the environment.[49] The new CEQ regulations establish certain procedures for an agency to follow in making this determination. First, the agency should determine whether the proposal is one which "normally" requires an EIS, in which case the agency may simply commence the EIS preparation process, or "normally does not" require an EIS.[50] The latter are called "categorical exclusions" and must be identified under agency procedures devised for that purpose.[51] If doubt remains, the agency must prepare an "environmental assessment," containing sufficient facts and analysis to support a decision that an impact statement is or is not required.[52] If the agency concludes that no impact statement is required, the agency must prepare and make available to the public a "finding of no significant impact" stating why the action was deemed to have no significant effects on the environment.[53]

An agency preparing an environmental assessment will find little guidance in NEPA itself in determining precisely which federal actions "significantly affect" the environment, for the statutory language is brief and vague. Furthermore, judicial attempts to devise more exact guidelines than the statute provides have not been widely accepted, for the unique array of facts which each environmental case presents undercuts generalization. It is nevertheless clear from the court decisions that few federal actions beyond the level of the truly insignificant can escape designation as "major" actions under NEPA, and, as one commentator has noted, close cases are resolved in favor of coverage.[54] Thus, an impact statement has been required for construction of an incinerator at the Walter Reed Medical Center Annex,[55] for the

49. There is some uncertainty whether this is a one-part test, whereby "major" and "significantly affect" simply reinforce one another, or a two-part test, whereby separate criteria must be met for an action to be both "major" and to affect "significantly" the environment. Under the two-part test, a "federal" action could significantly affect the environment but be too "minor" and insignificant an exercise of federal power to require an EIS. *See* NAACP v. Medical Center, Inc., 584 F.2d 619 (3rd Cir. 1978). The new CEQ regulations, in an attempt to foreclose this possibility, state that "major reinforces but does not have meaning independent of significantly." 43 Fed. Reg. 56,004 (1978) (to be codified in 40 C.F.R. § 1508.18).
50. 43 Fed. Reg. 55,992 (1978) (to be codified in 40 C.F.R. § 1508.4).
51. 43 Fed. Reg. 56,003-56,004 (1978) (to be codified in 40 C.F.R. § 1501.4).
52. 43 Fed. Reg. 55,992 (1978) (to be codified in 40 C.F.R. § 1501.4).
53. *Id.*
54. *Handbook, supra* note 5, at 753.
55. Montgomery County v. Richardson, 2 Envt'l L. Rep. 20140 (D.D.C. 1972).

Forest Service's routine approval of modifications and extensions of existing logging contracts within a national forest[56] and for the Corps of Engineers' condemnation of less than 250 acres of grazing land for a flood control project.[57]

Still, there are cases holding that federal actions of a truly *de minimis* impact are exempt from the requirement for an EIS. Thus, the environmental impact was judged insignificant where the Forest Service planned to construct 4.3 miles of one-lane gravel road in a national forest area already "honeycombed" with roads and paths, to complete a 16-mile highway segment begun 30 years before;[58] where the Forest Service made changes in a timber "set-aside" program which did not affect the manner of logging or volume of timber harvested each year,[59] and where the Interior Department planned to issue coal leases on 120 acres unsuitable for other purposes and adjacent to existing coal leases covering more than 5,000 acres.[60]

The new CEQ regulations spread a wide net of NEPA coverage by defining "major" actions "significantly affecting" the human environment in extremely broad terms. "Major federal action" is defined to include "actions with effects that *may* be major."[61] Thus, not the certainty but the mere possibility of "major" effects suffices. "Effects" are defined to include "direct" effects, caused by the action and occurring at the same time and place; "indirect" effects, which are caused by the action, and, though later in time or removed in distance, still "reasonably foreseeable,"[62] and "cumulative" effects, which result from individually minor but collectively significant" actions.[63] Various kinds of socioeconomic impacts may constitute "indirect" effects, including "growth-inducing effects and other effects related to indirect changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems."[64]

Effects are said to include ecological, aesthetic, historic, cultural, economic, social, or health effects, whether direct, indirect, or cumula-

56. Minnesota Public Interest Research Group v. Butz, 498 F.2d 1314 (8th Cir. 1974) (*en banc*).
57. United States v. 247.37 Acres, 3 Envt'l Rep.-Cases 1098 (S.D. Ohio 1971), 3 Envt'l Rep.-Cases 1696 (S.D. Ohio 1972).
58. Kisner v. Butz, 350 F. Supp. 310 (N.D. W. Va. 1972).
59. Duke City Lumber Co. v. Butz, 382 F. Supp. 362 (D.D.C. 1974), *aff'd*, 539 F.2d 220 (1976), *cert. denied*, 429 U.S. 1039 (1977).
60. Jicarilla Apache Tribe v. Morton, 3 Envt'l Rep.-Cases 1919 (D. Ariz. 1972).
61. 43 Fed. Reg. 56,004 (1978) (to be codified in 40 C.F.R. § 1508.18) (emphasis added).
62. *Id.* (to be codified in 40 C.F.R. § 1508.8).
63. *Id.* (to be codified in 40 C.F.R. § 1508.7).
64. *Id.* (to be codified in 40 C.F.R. § 1508.8).

tive.[65] Finally, a "significant" effect may exist even if an agency believes that on balance the overall impact of an action will be beneficial.[66]

Therefore, to insure a correct environmental assessment of the significance of a proposed action, an agency must make a systematic and complete inventory of every potential impact on the environment. Then the agency can make an informed decision whether the action is "significant" and requires an impact statement or instead falls within the *de minimis* exception and qualifies for a "finding of no significant impact."

Obviously, the kinds of impacts inventoried will depend in large part on the scope of the action. For illustrative purposes, there follow below descriptive inventories of environmental impacts from three possible federal actions in the wind energy field: (a) construction of a single 1.5 MW wind machine; (b) development of a "wind farm" with 100 or more 1.5 MW machines and (c) adoption of a broad program of federal participation and incentives promoting wind energy, designed to attain the "maximum practical" wind energy contribution of 1.7 quads[67] by the year 2000. These inventories will also serve to illustrate the point made earlier, that even environmentally preferable energy alternatives can have significant environmental impacts which may call for scrutiny under NEPA.

1. *The 1.5 MW Wind Machine*[68]

Construction of a horizontal axis wind machine rated at 1.5 MW is well within current technology; comparable machines have been built.[69] Such a machine might consist of two blades fixed to a horizontal drive shaft in a streamlined housing, or nacelle, all mounted atop a steel-truss tower, similar in appearance to an electric transmission line tower. The nacelle would contain electric generating equipment and would be rotated on a vertical axis to keep the blades turned into the wind. The blades would be constructed of steel, aluminum, or a synthetic material such as fiberglass. Rotor diameter would be between 150 and 200 feet, with a tower height of 100-135 feet. Rotor blades would revolve at no more than 40 rpm. Power cables, one or more trans-

65. *Id.*
66. 43 Fed. Reg. 56,005-56,006 (1978) (to be codified in 40 C.F.R. § 1508.27 (B)(1)).
67. *Domestic Policy Review, supra* note 14, Table III, at V-7.
68. This discussion of the structure and environmental impacts of a single 1.5 MW machine is based on information contained in the *Block Island EIS, supra* note 24, and the *ERDA Wind Environmental Assessment, supra* note 13.
69. See II, notes 10-24, *supra.*

formers and other electrical equipment would be needed to join the wind machine with a utility grid. The land area required for the machine itself, plus ancillary facilities such as control buildings and roads, would be approximately three-quarters to one and one-half acres.

Complete assessment of the environmental impacts of such a machine requires consideration of its entire life cycle. A wind machine, like many other technological devices, has four distinct life cycle stages: *fabrication,* involving manufacture (often following mining of raw materials) of various components in the unassembled machine; *installation,* involving site preparation and machine construction; *operation,* during which energy is produced; and *decommissioning,* occurring at the end of the machine's useful life.

The incremental effects of mining of raw materials and manufacturing components for a single machine would be trivial. Similarly, the disposal of the machine after its useful life of 20 to 30 years would cause little if any discernible environmental impact.

The environmental impacts of the installation and operation phases would be more pronounced. Installation would involve impacts like those of any construction project; namely, some production of fugitive dust, added motor vehicle emissions and heavy equipment noise, and possible soil erosion and siltation of surface waters. In addition, 10 to 20 construction workers would be required. In a remote area, the resulting increase in demand for water, sewage, or other services could possibly have more than a minor impact.

Operation of a wind machine is the stage with the most numerous potential impacts. Of course, the machine itself produces no water or air pollution or solid waste; however, there are possible environmental effects of the following types:

Aesthetic Effects. Some concern has been expressed that modern wind machines, given their size and shape, may present an undesirable visual intrusion on the landscape. In the past, windmills have been considered picturesque, but this reaction appears to be limited to the rustic "old Dutch" style.[70] Attempts to measure public response to the futuristic-looking machines which are most efficient yield ambiguous results at best.[71] Furthermore, screening devices which may be appropriate for similar towers — such as vegetative screens or siting on the downside of a ridge rather than the peak — would decrease the machine's efficiency by blocking access to the wind. The aesthetic im-

70. Survey Research Laboratory, Univ. of Ill., *Public Reactions to Wind Energy Devices,* NSF/RA-77-0026, Oct. 1977, report prepared for the National Science Foundation, at 6-10 [hereinafter cited as *Report on Public Reactions to Wind*].

71. *Id.* at 8.

pact would vary with the siting, prominence, color, and configuration of a machine. What might be a welcome visual point of interest on the plains of Kansas could be an intrusion on the Maine coast. In sum, the aesthetic impact is a potentially significant environmental effect, even for a single machine.

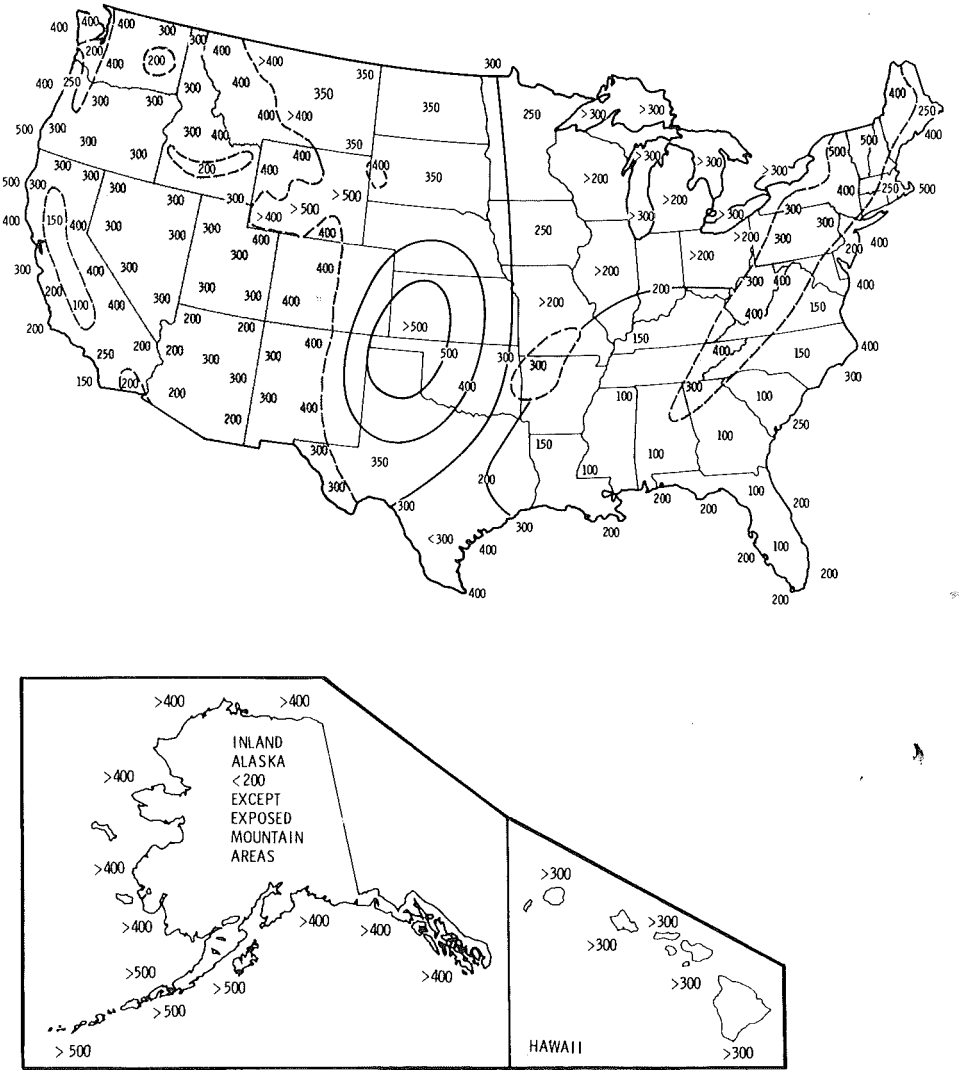
TV Interference. Moving metal windmill blades can, in certain locations, interfere with television transmission signals, causing poor reception. Sample calculations show that the radius of signal interference could be up to one-quarter mile for conventional VHF signals and three miles for UHF signals. Proper siting, as well as use of nonmetallic blades,[72] would substantially reduce the problem. Again, the significance of this potential impact would vary considerably with the location of a machine.

Safety Factors. The new CEQ regulations state that impacts on public health and safety are relevant to the "significance" of a given action.[73] If a wind machine underwent a structural failure, the risk to humans or nearby structures would be a real one. Blade failure in a 1.5 MW machine could result in fragments being flung out to a distance of a quarter-mile. Tower collapse would present similar dangers over a more restricted area. The physical presence of a large wind machine could present a risk to low-flying aircraft, although FAA regulations might minimize this risk. Finally, an operating wind system would pose problems of occupational safety for its workers; this risk would depend on whether the machine is manned or unmanned. Obviously, the magnitude of these risks could be drastically reduced by a variety of precautions, including safety features designed into the machine, a limited-access safety zone around the machine, proper lighting and marking of the tower, and siting at a sufficient distance from human habitations. By the same token, if a large machine had to be sited in a populated area for economic or other reasons, the potential safety factors might well rise to the level of a significant impact on the environment.

Effects on Animal Life. Wind machine towers and rotating blades present potential collision hazards to birds, bats, and insects. Since birds and bats are able to learn to avoid obstacles placed in their territory, the primary risk would be to migrating bird species. The risk would be small for high flying migratory waterfowl, but would increase for low flying nocturnal migrants, such as many songbirds. Approximately

72. Some researchers believe non-metallic blades may predominate anyway because they seem to cost less. Telephone interview with Frederick W. Perkins, associate research engineer, SERI, Feb. 23, 1979.
73. 43 Fed. Reg. 56,006 (1978) (to be codified in 40 C.F.R. § 1508.27(b)(2)).

ANNUAL AVERAGE WIND POWER (WATTS/M^2) AT 50 M



Map — Battelle Pacific Northwest Laboratory

Potential aesthetic and other concerns related to wind energy devices may vary with the proposed wind energy site. Though conditions on a local scale are of great importance in assessing wind energy potential, this map indicates regions which appear to have large wind energy potential on an area-wide basis.

eight percent of birds flying through the disk area swept by the machine blades would be struck if, due to darkness or other poor visibility factors, they took no evasive action. However, unless forced lower by weather conditions, even migratory songbirds normally fly at an altitude of 500 to 1,000 feet, well above the height of any existing or proposed wind machine. If the machine were sited outside the migratory path of such species or if a light or sound warning device were used, the adverse impact of a single machine might well be negligible.

The impact of one machine on terrestrial species would likewise appear to be minor, unless the particular site chosen happened to coincide with the habitat of a rare or endangered species or interfered with terrestrial migrations.

Effects on Microclimate and Vegetation. Downwind microclimatic variations associated with windbreaks include decreased wind speed, increased relative humidity, and increased soil moisture. However, the magnitude of these changes resulting from a single wind machine is expected to be slight. Little measurable impact on nearby vegetation would occur.

Habitat Impacts. A wind machine would have little habitat impact on the sites most likely to be chosen, such as plains or treeless coastal areas. However, siting in forested areas might require considerable clearcutting to insure an unobstructed wind flow. Soil erosion, siltation of water, and plant and animal habitat destruction could be the result.

Noise. Noise and vibration levels associated with wind machines have not been extensively studied. There is a possibility that a large machine would have a significant noise impact on nearby dwellings, but preliminary research indicates that this impact would be slight.

Socioeconomic Impacts. The operational work force for a single machine would be quite small, and no perceptible biophysical or socioeconomic impacts are likely to result from its presence. Likewise, the added power provided by a single machine is unlikely to spur much, if any, associated industrial or population growth.

Two conclusions emerge from the foregoing inventory for a 1.5 MW machine. First, it is difficult to predict in the abstract whether a given project of such small size will or will not "significantly" affect the environment. The same impact might be "significant" in one location and unimportant in another. Therefore, each project must be evaluated on its own merits and in its specific environmental context. This is precisely the kind of analysis which an environmental assessment is meant to force, so that hard facts rather than generalizations about environmental impacts become part of agency decisionmaking on a project.

Second, many potentially "significant" impacts can be reduced to the level of insignificance by relatively minor modifications, such as choosing a different site. Again, such mitigative measures are the kind of result which NEPA is meant to foster[74] and are made more likely by NEPA's mandatory assessment of possible environmental impacts.

2. *The Wind Farm*

Large-scale production of electricity by the wind is likely to involve development of "farms" with numerous machines. Wind farms of 100 or more large machines have already been suggested.[75] For each life cycle phase, the environmental impacts of such a farm would substantially multiply the impacts of a single 1.5 MW machine. Component fabrication for a large farm might entail a significant increase in raw material use and manufacturing effort, with possible associated increases in air or water pollution. The decommissioning of a wind farm would involve some of the same impacts as construction (heavy machinery use, fugitive dust) and require disposal of substantial tonnages of materials. Again, however, installation and operation would have the largest potential impacts.

Approximately 10 to 20 construction workers would be required per 1.5 MW machine.[76] A farm of 100 machines would thus require hundreds or even a thousand or more workers, depending on the construction schedule. An influx of this size could have substantial impacts on a rural area or small town, similar to those being experienced in western mining "boom towns." Overloaded water and sewage systems; over-extended housing, medical and educational facilities; rapid wage inflation — all are potential impacts of the installment phase. Likewise, the fugitive dust emissions, possible soil erosion, motor vehicle emissions, and heavy equipment noise which accompany construction would be multiplied many-fold over the single machine case. When these impacts become sufficiently large, they can have adverse effects on animal and plant life in the area.

74. *See* NEPA § 101(b), 42 U.S.C. § 4331(b), requiring federal agencies to use "all practicable means, consistent with other essential considerations of national policy," to carry out their programs with due regard for environmental values, including the preservation of important "historic, cultural and natural aspects" of the national heritage and of "safe, healthful, productive, and esthetically and culturally pleasing surroundings."
75. D. M. Hardy, *Regional Wind Energy Development*, SERI/TP-36-050, paper presented at Solar '78 Northwest Conference, July 14-16, 1978 Golden, CO: SERI; Aug. 1978 (NTIS), at 6-9.
76. *ERDA Wind Environmental Assessment, supra* note 13, at 17.

The impacts from the operation phase would also be much increased. For example, the surface area required for a wind farm would be immense, since machines must be placed sufficiently far apart to prevent mutual interference with the wind. Sixteen or fewer large machines per square mile is one estimate of a workable concentration.[77] A hundred-machine farm would thus cover more than six square miles. The possibilities for compatible simultaneous uses of the land are difficult to predict but may be quite limited. The exclusion of alternative land uses over a large area can itself be a significant environmental impact. The aesthetic impacts of a wind farm are difficult to assess, but there is at least some evidence that an array of wind machines, which bears a marked resemblance to a line of electric transmission towers, is less favorably viewed by the public than a single machine.[78]

The aesthetic and physical impacts associated with a wind farm would be increased, perhaps substantially, by the need for ancillary facilities and equipment to deliver the power generated. Transmission lines, transformer stations, power storage facilities (for example, pumped storage hydro plants, in which wind-generated electric power could be used to pump water uphill during periods of low demand, to be released to turn turbines and generate power during periods of higher demand) and other structures might be required. The impacts of these facilities, although "indirect," are properly included in the total inventory of a wind farm's environmental effects.

The socioeconomic impacts of an operating wind farm could be substantial. A permanent work force of some size would be needed to oversee operations and maintain the machines. In a nonurban area, the added population could cause some of the same impacts on utilities and social services as would the construction work force. Perhaps more significant would be the associated industrial or population growth stimulated by a large increase in the power supply. All the impacts connected with economic growth — more people, vehicles, buildings, air and water pollution, greater demand for resources, and greater disruption of the natural environment — could thus be the indirect result of a wind farm. The other potential impacts discussed with respect to a single machine — safety, effects on bird and animal life, effects on vegetation, microclimate, and habitat impacts — would vary with the location and surrounding environment, but one or more of

77. *Wind Legal-Institutional Implications, supra* note 1, at 48. This estimate is for a wind farm consisting of 1 MW machines. The larger machines discussed here would have to be spaced somewhat further apart.
78. *Report on Public Reactions to Wind, supra* note 70, at 8.

these impacts is likely to become "significant" in the context of an entire wind farm.

In sum, the probability that a wind farm would constitute a "major" action "significantly affecting" the environment is quite large, and an impact statement would probably be required. Given the potential magnitude of the environmental impacts, careful scrutiny of such a project pursuant to NEPA is not an unreasonable safeguard.

3. *Federal Adoption of a 1.7 Quad Wind Program*

The Domestic Policy Review estimates the "maximum practical" wind energy contribution by the year 2000 at 1.7 quads,[79] which would require substantially expanded federal efforts to promote solar energy. This level would entail about 45,000 1.5 MW machines. There are many possible combinations of larger or smaller machines, scaled to domestic, industrial, or utility use to produce an equivalent amount of power, arranged singly, in wind farms or in floating off-shore arrays, located in urban or rural areas, funded by private spending, federal grants or tax incentives. Accordingly, it is difficult to say when and how many environmental impact statements would be required if the "maximum practical" scenario were adopted. Even in gross terms, however, some of the land, material, and labor requirements of large-scale wind development give an idea of the potential magnitude of the environmental impacts.

The central problem for any solar technology is that solar energy is diffuse. Large quantities of resources must be devoted to collecting, concentrating, and converting the solar energy into a more usable form. Consequently, it is possible that solar technologies will be more material and resource intensive than fossil fuel plants of equal power production.[80] Thus, while *operation* of a fossil fuel power plant will produce far more air pollution than operation of a comparable solar array, the *fabrication* of the solar components may cause substantial amounts of air or water pollution as the necessary metals and other materials are produced and processed. Of course, the fossil fuel plant produces pollutants in a relatively concentrated area, while the pollutions associated with

79. *Domestic Policy Review, supra* note 14, Table III, at V-7.
80. K. A. Lawrence, "A Review of the Environmental Effects and Benefits of Selected Solar Energy Technologies," A.E. St. Clair, ed.,*Proceedings of the Amer. Nuclear Society Conf. on Environmental Aspects of Non-Conventional Energy Resources* - II, Topical Meeting, Sept. 26-29, 1978; Denver, CO. (La Grange, Ill.: Amer. Nuclear Society; 1978), at 4-4 [hereinafter cited as "Solar Technologies Environmental Review"].

solar component manufacture are likely to be dispersed in manufacturing centers throughout the country. Nevertheless, credible environmental comparisons of energy forms cannot be performed without considering the hidden impacts from all life cycle phases in addition to operation.

Material Requirements. Substantial quantities of aluminum, concrete, copper, fiberglass, and steel would be required for large-scale production of wind machines. Based on the Domestic Policy Review's estimate of 45,000 large machines, it can be roughly calculated that over 300,000 tons of aluminum, 150,000 tons of copper, 15,000,000 tons of steel, 900,000 tons of fiberglass, and 16,000,000 tons of concrete would be required to construct the needed components and machines.[81] Significant particulate emissions are associated with the production of all of these substances; sulfur dioxide emissions are associated with concrete, steel, and fiberglass production; steel and aluminum production releases fluorides. A host of impacts other than air pollution would be expected to follow from the production of these materials in such quantities. Raw material extraction would entail mining, with consequent air, water, and surface impacts, as well as use of large amounts of energy. Solid waste and water pollution problems would be presented at various points along the production chain. Associated population shifts or socioeconomic impacts can also be anticipated. Occupational health and safety issues are likewise presented, particularly with respect to increased production of fiberglass, which has well-known carcinogenic properties.

Labor Requirements. The Domestic Policy Review estimates that the gross cumulative labor requirements, direct and indirect, devoted to wind energy under the "maximum practical" option to the year 2000 would be approximately 1,560,000 work years.[82] On an annual basis, that amounts to about 70,000 to 80,000 work years.

Land Requirements. Estimates vary widely of the amount of surface area needed for wind machines. Clearly the area required will depend on the deployment techniques used; housetop windmills would represent a very different impact than massive wind farms. But it seems likely that the 1.7 quad scenario would entail use of at least 1,000 and perhaps up to 30,000 square miles of surface area.[83] The productive

81. These numbers are derived by multiplying tons of material required per megawatt of wind energy, *id.* Table 1, times the 67,500 megawatts which the "maximum potential" scenario entails. Obviously, this method provides a general rather than precise idea of the amounts of materials required.
82. *Domestic Policy Review, supra* note 14, Table IV, at V-13.
83. *See* "Solar Technologies Environmental Review," *supra* note 80, Table I, and *Wind Legal-Institutional Implications, supra* note 1, at 48.

use of arable land could be impaired by devoting massive land areas to wind energy production. More likely, significant aesthetic impacts could result, particularly since some of the better locations from an operational standpoint — seacoasts and mountain ranges — have important visual values which might be disrupted by chains of giant wind machines.

Based on these impacts, it is safe to conclude that the preparation of one or more impact statements would be required before implementation of the "maximum practical" wind energy option by the federal government.

IV
CONCLUSION

Wind may well be one of the most environmentally sound energy alternatives available. Nevertheless, as the inventories of impacts in this article illustrate, even wind energy has its environmental effects.

This article analyzes the problem of whether and when NEPA applies to alternative energy sources, using wind energy as a case study. The three issues which determine whether and when an environmental impact statement is required can be summarized as follows: (1) Is there a "recommendation or report on a proposal" for (2) "federal" action (3) that is "major" and will "significantly affect" the environment?

A lively awareness of how NEPA works serves two important functions. First, an agency or individual attuned to the requirements of NEPA is more likely to take the necessary procedural steps to comply with the statute and less likely to see a worthwhile project mired in litigation, as lawyers quarrel over the precise meaning of a "federal" or "significant" action. Second, the process of preparing an environmental assessment (and, if necessary, an environmental impact statement) can serve important ends. By forcing project proponents to confront the full range of possible environmental impacts, balance competing values and search out mitigating actions, NEPA promotes decision making by federal agencies which will be environmentally more sensitive and ultimately more wise.

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